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RESEARCH ARTICLE

THE EFFECTS OF PILATES EXERCISES ON BALANCE IN FEMALES

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ABSTRACT

Background/Objective: The aim of this research is to determine the effects of Pilates exercises on balance in females.
Methods: Sixty sedentary women volunteers (mean age = 34.67 ± 10.41 years; height = 158.75 ± 4.68 cm; weight = 76.22 ± 11.94 kg) participated in this research. Each subject was randomly allocated to the Experimental Group (EG=30) or the Control Group (CG=30). The EG performed the Pilates exercise program. In eyes open condition, there was no significantly difference in the control group ($p>0.05$) while Overall Stability Index (OSI) scores significantly decreased in the experimental group after the exercises ($p<0.05$). Under the eyes closed condition, a significant difference was seen in OSI scores before and after the exercises ($p<0.05$).
Results: In conclusion, this study shows that an 8-weeks Pilates exercise program contributes to an increase in the ability to control the body's position or balance for sedentary adult females through improvements in physical activity and positions.

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INTRODUCTION

Balance means adjusting muscle function and joint position and preserving the center of gravity for the body to maintain the required function (Ragnasrdottir, 1996). Maintaining posture is important for sport and normal daily activities (Lepers *et al.,* 1997). Balance is a complex process including coordinated activities of many sensory, motor, and biomechanical components (Guskiewicz, 2004). Although balance is often thought to be a static process, it is eventually an integrated dynamic process including many neurological ways in fact (Nashner, 1997). Normal balance requires the control of both powers regarding gravity to maintain posture and acceleration powers to maintain balance (Huxham *et al.,* 2001). Some muscles have the function of maintaining postural control, so these muscles are called postural muscles. These muscles are the transverse abdominals, the internal and external oblique muscles. Postural muscles provide the truncalstability which plays a vital role in balance (Mullhearn and George, 1999). Pilates is a popular form of exercise among women all around the world (Chang, 2000). Pilates, aiming activity of muscles in the core of the body, consists of low-density muscle activities (Chang, 2000; Siler, 2000). As a method of body conditioning, Pilates was developed by Josep H. Pilates during the First World War. Pilates consists of over 500 strengthening and stretching exercises (Friedman and Eisen, 2005). Pilates characterizes the center of body as the powerhouse of body. This exercise method is primarily based on the necessity of strengthening and stretching all body parts (Muscolino and Cipriani, 2004). Generally, Pilates exercises are part of the training programs prepared for healthy people as a part of general fitness programs. In recent years, it has been also used for the purpose of medical therapy related to various muscle-skeleton central nervous system (CNS) (Altan *et al.,* 2012; Blum, 2012; Levine *et al.,* 2007). The large number of studies applying Pilates Method as an intervention program is those that used it for treating pain. Additionally the Pilates Method is preferred for the improvement of aerobic capacity, Body Mass Index (BMI), flexibility, and posture stability. Further, Pilates Method stands out with a high number of studies that analyze its effects, clearly its exercises effects, on the abdominal muscles (González-Gálvez *et al.,* 2012). Pilates is recommended to improve fitness, posture, core strength, peripheral mobility, CNS disorders, and to treat people with low-back pain and rheumatoid arthritis (Segal *et al.,* 2004). Pilates exercises strengthen athletic performance as well as core stability and flexibility (Segal *et al.,* 2004; Anderson and

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Spector, 2005; Hutchinson *et al.,* 1998). Kloubec (2010) explains that pilates exercises improve joint movements on elbows and endurance on the upper extreme and core muscles. In another study, the writers emphasize that Pilates exercises can develop truncal flexibility in healthy adults (Segal *et al.,* 2004). The activations of the Transversusabdominis (TrA) and Obliquusinternusabdominis (OI) increase among daily life activities or sport activities due to Pilates exercises (Muscolino and Cipriani, 2004). Pilates, developing some characteristics such as core strength, peripheral mobility, abdominal endurance, is likely to improve balance skill which has a vital role for daily life. It should be revealed that Pilates practices positively influence the balance scores. In this study, it was hypothesized that Pilates exercises would positively affect the maintenance of body balance while these exercises had effects on the development of other postural muscles as well as core muscles. The recent studies provide some evidences showing that pilates trainings have positive effects on the balance scores even if they are so poor (Aladro-Gonzalvo *et al.,* 2012).

Objectives

Does it pilates exercise impact on balance? The aim of the research was to determine the positive or negative effects of pilates exercises on the balance skills of the sedentary adult females. The limitation of the study was no control and insufficient of the nutritional status, the limited standardization on measurement techniques, a lack of true experimental research designs, and inconsistent instructor qualifications.

METHODS

Sixty sedentary women volunteers (mean age=34.67±10.41 years; height=158.75±4.68 cm; weight=76.22±11.94 kg) participated in this investigation.

Participants

Each subject was randomly allocated to the experimental group (EG=30) or the control group (CG=30). EG applied the pilates exercise program. The females in CG were told to maintain their daily life during the study, and they were not asked to participate any extra activities throughout the duration of the study. The subjects were informed of the possible benefits and risks of the study. In the participant women did not any negative physical and mental aspects. The subjects of the study were not given any additional incentives motivating them to be part of the study. To participate the study did not required any cost from the subjects. The research procedure was signed by the Local Ethics Commission. Before the study, the subjects of both CG and EC were provided some explanation about the informed consent form approved by the Local Ethics Commission and were asked to sign the informed consent form.

Collection of Data

Testing Procedure

Postural Stability Assessment

The Biodex Balance System (BBS) was used as an effective device to measure balance (Biodex Medical Systems Inc., Shirley, NY, USA). The system consisting of circular moveable platform and being interfaced with computer software enables the objective measurement of the balance scores (Salavati *et al.,* 2007). Eight strings enabling the resistance to movement were located the outer edge of the platform. The resistance levels in BBS range from 12 to 1. The balance score of the subject on the platform has shown the overall level of the balance skill of the subject (Erkmen *et al.,* 2010; Testerman and VanderGriend, 1999). The subject having high balance score would have the poor OSI score. The applied tests consisted of the subjects performing the one-leg stand with eyes open and eyes closed. The one-leg stand test was performed on the dominant leg, as determined by the limb which the subject would preferentially use to kick a ball through. The resistance level used was set at a static level in both the EO and EC tests. During the test, subjects stood bare foot on a platform and attempted to keep the platform level for 20 seconds. The platform interfaced with computer software was locked not to move to measure the foot position and to have the ideal foot position. The subjects were allowed to adjust their foot position untıl they have the balance on the platform. Additionally, they were let to look straight at the instrument board as they adjusted their foot position. And then, the platform was fixed and the foot positions of the subjects were recorded. During the test, the foot position coordinates of the subjects were not changed. And then before the main test, the subjects were tested twice. During the measurement, the subjects were asked to stand through the dominant foot on the platform and to place other leg on the 90 flexion position. Then, their balance scores wre recorded at that position. During the test, the subjects were prevented to see the feedback on the BBS by covering the instrument panel. They were asked to look straight at eye level. The measurement were taken twice before and after pilates exercises. In this work, CG which did not subject to training, continue the normal life and did not participate any physical activity. All measurements were recorded at the baseline after the study at once.

Pilates Training Program

The training were adapted (Sekendiz *et al.,* 2007; Culligan *et al.,* 2010; Emery *et al.,* 2010) and performed on a mat and ball. This study were applied by specialist trainer 3 days per week for 60 minutes. Subject's mistakes were instantly corrected by intervening (Table 1).

Statistical analyses

To analyze the data of the study, SPSS program were used. The Shapiro-Wilk test was used to verify that all variables were normally distributed. EG and CG were compared through unpaired t-test. The mean values from the pre-test and post-test about the balance scores were compared by paired t-tests. The alpha level was set a priori at 0.05 to indicate the significance level for all statistical tests.

RESULTS

There was no significant difference in age ($t = 0.892$; $p > 0.05$), body height ($t = -1.303$; $p > 0.05$), body weight ($t = 0.044$; $p > 0.05$), BMI ($t = 0.434$; $p > 0.05$ or body fat % ($t = 1.121$; $p > 0.05$) before the Pilates exercise program for control and experimental group. While a statistically meaningful difference was seen in the averages of body mass, BMI and body fat percent after exercises for subjects in the EG ($p<0.05$), there was no difference in CG ($p >0.05$; Table.3).

Table 1. The Pilates training program

	1-4 weeks	5-8 weeks	
Monday	warm up 10 min	warm up 10 min.	
	Pilates Mat	Pilates Mat and ball	
	Training (8x2) 40 min.	Training (8x3) 45 min.	
	cooling 10 min.	cooling 10 min.	
Wednesday	warm up 10 min.	warm up 10 min.	
	Pilates Mat	Pilates Mat and ball	
	Training (8x2) 40 min.	Training (8x3) 45 min.	
	cooling 10 min.	cooling 10 min.	
Friday	warm up 10 min.	warm up 10 min.	
	Pilates Mat and ball	Pilates Mat and ball	
	Training (8x2) 40 min.	Training (8x3) 45 min.	
	cooling 10 min.	cooling 10 min.	
Warm up	Pilates Mat Training	Pilates Ball Training	
- Breathing			
- Imprint and release	- The Hundred	-Sitting On The Ball	
- Spinal rotation	- The Shoulder Bridge	-Bent Knee To Leg Extension	
- Cat stretch	- Single Leg Circle	-The Saw	
-Hip rolls	- Swimming	- Roll- Up	-Flexibility exercise
- Scapula isolation	- One Leg Stretch	-Spine Stretch And Spine Stretch Forward	-Stretching exercise
- Arm circles	- Double Leg Stretch	-Balance Push-Up	
	- Rolling Like a Ball	-Bent-Knee Bride	
	- The Saw	-Lie Back Stretch	
	- Roll Up	-Single Leg Stretch Knee Stretch	
	- Spine Strech	-Single Leg Stretch Also Known As Scissors	
	- Leg Pull Down	- Basic Ball Crunch	
	- Leg Pull Up	-HumstringCurl	
	- Push Up	-Gluteus Kıck Back	
	- Pelvic Curl	-Water fall	
	- Side Bend	-Abdominal crunch	
	- Side Kick Front	-Bent-Knee Bride	
	- Side Kick Back	-Knee Stretch	
		-Leg Knee Up	
		-Bridge Hamstring Curl	

Table 2. Descriptive statistics for experimental group (n=30) and control group (n=30)

Groups	Age (year)		Height (cm)		Body mass (kg)		BMI (kg/m2)		% Body fat	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
EG	35.87	8.64	157.97	3.62	76.29	12.13	30.65	5.22	34.12	3.90
CG	33.47	11.94	159.53	5.50	76.15	11.96	30.06	5.34	33.28	4.44

Table 3. Comparisons and means of subjects' Body Mass, BMI and % body fat before and after exercises

Variables	Groups	Pre-exercise		Post-exercise		T
		Mean	SD	Mean	SD	
Body Mass (kg)	Group exercise	76.29	12.13	74.50	12.01	5.529 *
	Group control	76.15	11.96	76.06	11.91	1.569
BMI	Group exercise	30.65	5.22	29.94	5.20	5.505 *
	Group control	30.09	5.43	30.02	5.32	1.608
Body Fat%	Group exercise	34.55	2.86	32.48	2.26	5.659 *
	Group control	33.28	4.44	33.01	4.22	1.850
* P < 0.05						

Table 4. Comparisons and means of subjects' OSI scores in EO and EC conditions

Conditions	Before exercise		After exercise		T	P
	Mean	SD	Mean	SD		
Eyes Open						
Group exercise	1.56	0.57	1.18	0.39	4.388	0.000*
Group control	1.53	0.42	1.52	0.38	0.902	0.375
Eyes Closed						
Group exercise	2.91	0.69	2.61	0.63	2.262	0.032*
Group control	2.89	0.75	2.87	0.73	1.682	0.103
* P<0.05						

In comparisons and means of subjects' OSI scores in EO and EC conditions. In EO condition, there was no difference in the control group ($p>0.05$), while OSI scores significantly decreased in the experimental group after the exercises ($p<0.05$). In EC condition, a significant difference was seen in OSI scores before and after the exercises ($p<0.05$). After the Pilates exercise program balance performance increased for subjects with eyes closed. Furthermore, there was no difference in OSI scores before and after exercises for the control group with eyes closed ($p>0.05$; Table4).

DISCUSSION

The aim of the study was to investigate the effects of the eight-week Pilates exercises on the balance performances of the sedentary adult females. According to the findings of the study, as compared the balance scores of the EC and CG, it was found that the balance scores of the EG significantly improve much more to the balance scores of the CG. Additionally, after the eight-week pilates exercise program, it was seen that the balance scores of the females in the EC progressed. A recent study, there is no correlation between the balance scores and endurance, flexibility, and trunk muscle activities. The eight-week pilates exercises have positive effects on core muscles, flexibility, and stable balance. On the other hand, these parameters have no effect on balance (Kibar *et al.,* 2015). Both traditional balance training and Pilates exercise programs are effective at improving balance scores in community dwelling older adults with fall risk, with the Pilates group showing improved balance confidence (Josephs *et al.,* 2016). It is known that Pilates exercises increase life quality for sedentary adult females (Sekendiz *et al.,* 2007). However, there is no compliance in research dealing with the effects of Pilates exercises on balance performance. While some research suggested that Pilates exercises caused an increase in balance performance (Anderson and Spector, 2005; Hall *et al.,* 1999; Johnson *et al.,* 2007) some of them explained these exercises did not affect balance performance (Kloubec, 2010; Caldwell *et al.,* 2009). Johnson *et al.* (2007) examined the effects of a 5-week Pilates exercise program applied in 10 sessions on dynamic balance performance in healthy adult subjects. A meaningful difference was found in dynamic balance scores after Pilates exercises. They informed that a 5-week Pilates exercise program developed dynamic balance. Hall *et al.* (2007) investigated the effects of Pilates exercises on balance in the elderly. They found that Pilates exercises applied over 10-weeks built up balance. In another study, it was informed that Pilates exercises improved dynamic balance in elder people (Babayigit-Irez *et al.,* 2011). These findings are in accordance with many related literature (Johnson *et al.,* 2007; Hall *et al.,* 2009; Babayigit-Irez *et al.,* 2011). Pilates exercises challenge the integration of the sensory, musculoskeletal, and nervous systems which contributes to the ability to maintain a balanced position. During Pilates exercises the effort for maintaining body balance increases overcoming with the possible strengths about losing balance for these systems. In this way, kinesthetic awareness of joints may increase. For this reason, Pilates exercises can be thought to develop balance performance. Johnson *et al.* (2007) declared that Pilates exercises improved motor control and increased joint awareness. Contrary to these studies, Kloubec *et al.* (2010) hypothesized that Pilates exercises applied twice a week for 12 weeks developed active males' and females' balance. However, they concluded in their research that balance did not improve. In the other research, Caldwell *et al.* (2009) noted that balance was not affected by Pilates exercises. They applied Pilates exercises on college students from Physical Education and Recreation Department. Since the subjects' fitness levels were high, any development could not be seen in balance. As being different from, Caldwell *et al.* (2009) in this research applied Pilates exercises for sedentary women aged 35.87 on average. Dissimilar findings of that study may be resulted from differences in fitness levels for these subjects. The perception of balance also improves through the positive effects of physical activity on muscles, joints and bones (Hall, 2007). Truncal stability is important for maintaining a balanced position. It is supplied with the help of postural muscles (Mullhearn and George, 1999). Pilates exercises intend to make the contractions of postural muscles stabilized (Muscolino and Cipriani, 2004). Based on the Pilates exercises applied for 8 weeks included in this research, the positive effects on body mass, BMI and body fat percent increase the level of physical activity for sedentary adult females. These Pilates exercises make the contractions of postural muscles stabilized and improve the perception of balance, which causes an increase in balance performance for both subjects with eyes open and subjects with eyes closed.

Conclusion

This study shows that an 8-week Pilates exercises program contributes to an increase in the ability to control the body's position for sedentary adult females through improvements in physical activity and positions. The pilates exercise adopts to have several benefits including improving postural control and balance.

Recommendation

All females should made regular physical activity for to physical and mental health. Also, exercise can impact on symptoms associated with inactivity. Therefore, females can participate to exercise for daily lifetime the least three times.

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